Energy performance contracting – an incentive for improving the energy performance of the building envelope in existing commercial office buildings

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Abstract

A number of barriers limit the uptake of energy efficiency in existing commercial buildings, namely access to finance, traditional lease agreements and access to suitable technical knowledge of technologies and methods that can be used to achieve energy savings in building operations.

Energy performance contracting (EPC) is used to remove some of the barriers to energy efficiency by providing a delivery mechanism that enables access to commercial financing, improves access to technical information and reduces project risks for the end user. In commercial buildings EPC has been traditionally applied to the substitution or retrofit of end-use technologies for lighting or heating ventilation and air conditioning (HVAC) services, whereby third party financing of the energy efficient improvement or measure is provided on the basis of *shared* or *guaranteed* savings contracts. Its application to tenanted buildings has largely been confined to government leases and educational facilities.

In this paper we examine the role of EPC as an incentive for improving the energy performance of the building envelope for buildings occupied by commercial tenants.

Two case studies are presented, with the analysis of energy efficient upgrades of the envelope for buildings located in cool-temperate climate zones (Wellington and Christchurch, New Zealand).

We review the contractual relationships in the traditional owner/tenant type lease agreement against "green leases" based on the green lease schedule developed in Australia by the Commonwealth Government, and propose a new framework for the implementation of building-envelope energy performance contracting (BE-EPC).

Introduction

ENERGY CONSUMPTION OF BUILDINGS

Buildings consume between 30% and 40% of the world's primary energy resources and typically around 10% of is consumed in commercial buildings [1]. Over 79% of this primary energy is sourced from fossil fuels [2], which places energy consumption from buildings around the world as a major contributor to anthropogenic emission of greenhouse gases (GHGs) and climate change.

End-use energy services within commercial buildings such as lighting, heating ventilation and air-conditioning (HVAC) are typically the major energy consumers. The energy performance of all of these services is influenced by the design and energy performance of the building envelope, which can be optimised during the design of a building, or reviewed and optimised as part of a building renovation or refurbishment.

BUILDING ENERGY PERFORMANCE UPGRADES – THE BARRIERS

Various market barriers and market failures hinder investment in building energy efficiency projects across the globe. An awareness of these issues is important to be able to understand how to determine an appropriate approach to removing these barriers and successfully implementing energy efficiency projects.

Access to finance

The investment required to achieve significant improvement in energy efficiency can be significant. As such projects will often require external financing. Financing and access to adequate financing through capital markets is one of the largest barriers to the deployment of Energy Conservation Measures (ECM's) [3].

Risk

Risk of underperformance can present "barriers to efficiency projects, or dissuade project teams from pursuing high levels of savings requiring new technologies or techniques" [4]. Perceived risk from historical failures can also present barriers to adoption of energy performance upgrades in buildings. Understanding the risks and potential strategies for managing these risks can help remove some of the barriers to pursuing building energy performance upgrades.

Access to building performance and energy efficiency knowledge

Many existing buildings do not have the facilities to enable detailed monitoring of energy use. Without this information, assessment of building energy performance requires in-depth and often costly energy audits – the benefits of which are not always apparent to the building occupier, let alone a building owner. Access to information is identified as a key market failure for the implementation of energy efficiency projects [3].

Traditional Lease Agreements

Commercial buildings are typically not owner occupied. Under traditional lease agreements typically the building owner does not bear the cost of operating the building services, therefore there is little incentive for them to improve the operational efficiency of existing building stock and plant. Should a tenant wish to reduce energy consumption, their options would typically be limited to improving the energy efficiency of office equipment and lighting (depending on the conditions of the lease relating to internal fit-out). The "split incentives" represent a significant barrier for the implementation of energy efficiency projects in commercial buildings [5].

Building Energy Performance

BUILDING ENERGY PERFORMANCE – INFLUENCING FACTORS

The actual energy consumption of typical buildings varies significantly from building to building and it is typically a function of:

- The design of the building envelope
- The internal layout and destination of use
- The equipment installed and the modes of operation of the equipment (lighting, office equipment etc.).

Other factors such as climate, siting, occupancy (and thermal comfort requirements) and equipment operation and maintenance also have a significant impact on the actual energy consumption of the building.

A building is a system and as such all of the components of the system interact and influence each other.

The building envelope is of particular importance because it provides the barrier between the external and internal environment of the building. The building envelope design determines:

- The air-tightness of a building
- The amount of heat transfer to or from the interior
- The amount of natural ventilation that can be used
- The amount of natural light that can be used

Location and the Building Envelope

Around the world there are many different types of construction that have evolved to account for the conditions specific to the various climatic zones.

The New Zealand Building Code (NZBC, Clause H1, 2007) defines three distinct climate zones that are used to categorise the requirements for thermal performance of the building envelope:

- Climate Zone 1 – covers Northland, Auckland and the Coromandel Peninsula (North Island)
- Climate Zone 2 – the rest of the North Island other than the Central Plateau
- Climate Zone 3 – the Central Plateau of the North Island and the whole of the South Island

Insulation and Thermal Mass

The level of insulation of the building envelope can have a significant impact on the energy performance of the building. For good thermal stability the building envelope should have a low response to external temperature variations and a high response to internal temperature variations. Walls with significant thermal mass exposed to the interior and insulation on the exterior will provide better thermal performance (translating into reduced energy use) than walls where all of the insulation is either in the middle of the wall system or on the interior [6].

Solar Orientation, Shading and Day-lighting

Energy consumption within a building is also significantly influenced by the solar orientation of the building and the use of shading and daylighting in the building design.

Solar orientation is often determined by the shape and location of the site, however its impact on the energy performance of a building can be quite marked as is will influence:

- Solar gain – both useful and detrimental
- Access to daylighting

In cool and temperate climates, solar energy gain through glazing can be used to warm the interior during cooler months [7]. However, without controls (passive or active) to minimise solar gain in the warmer months, excessive solar gain can lead to overheating which in turn would increase the loads on HVAC systems in order to maintain internal thermal comfort.

Shading (either external or integral with fenestration) can be utilised to reduce the impact of solar gain while maintaining the utility of natural daylighting. Various authors have reported on the impact of shading on building energy performance [8, 9]. Tzempelikos et al [9] found that the provision of active shading control and active lighting control can reduce total energy demand by up to 30%.

Artificial lighting alone can account for up to 35% of energy consumption in a typical commercial building [10]. By utilising daylighting, significant reductions in energy consumption can be obtained. The use of active lighting control has been shown to save up to 22% of the total energy demand for a commercial office building [9].

Hygrothermal Performance of the Building Envelope

The energy performance of the building can also be influenced by the hygrothermal performance of the envelope. For example, if a building's envelope has capacity to buffer humidity developed inside the building during periods when the AC is not operating – for example in a hotel room [11] – the latent heat that must be removed as a result of vapour release from the envelope when the AC is switched on adds load to the system that may not be required if the envelope either does not buffer the humidity or actually "breathes".

The location of the building has an influence on the desirable characteristics of the envelope in terms hygrothermal performance. Typically in cold climates, it is desirable to allow the building envelope to dry to the outside and limit moisture from the interior entering the envelope using a vapour retarder on the internal side of the various building elements. The reverse is typically applied in hot, humid climates where drying of the envelope is typically to the inside of the building and vapour retarders are installed on the exterior side of the various building elements [12].

While practical measurement of the hygrothermal performance of the building envelope may be difficult for existing buildings, it important to recognise how envelope systems interact with the external and internal environment, how this interaction may influence energy consumption in a building and therefore consider this factor when analysing building envelope systems for retrofit projects.

BUILDING PERFORMANCE – INDICES

Measurement of building energy performance can provide a guide to the overall energy efficiency of a facility. It can also be used to assess the impact of improvements to building systems of building fabric on overall energy consumption.

In New Zealand, the Code of Practice for Energy Conservation in Non-residential Buildings (NZS 4220:1982) presents energy consumption targets for new and existing buildings. For typical commercial buildings the targets defined are as follows:

- Existing buildings **200 kWh/m²** gross floor area per year
- New buildings **100 kWh/m²** gross floor area per year

This broad metric provides an overall assessment of a building's energy performance (energy density), however it does not facilitate the assessment of the specific energy end uses or the efficiency of those end uses – i.e. lighting, heating, cooling or ventilation. Additional equipment for measurement may be required to isolate and identify individual energy systems performance or to define the impact of certain building fabric or systems elements on the overall building energy performance.

ENERGY MODELLING

As building systems all interact, making improvements to one component of the building envelope, or the buildings mechanical or electrical services can have an impact on the overall energy consumption of the building. This impact can be positive or negative, thus it is important to take a systemic approach when assessing these interactions. Computer simulation is one of the most effective means of assessing these interactions.

In order to assess the impact of modifications, a baseline must be established. For existing buildings this may require measurement of actual energy consumption and a survey of the building envelope to confirm the materials of construction and thus the likely thermal properties. The baseline performance is determined using existing operations regimes, the overall building energy performance parameters and environmental parameters relevant to the building's location. The baseline building energy performance index can then be compared to the building energy performance index following modifications to the building system (building services, envelope or operations regime).

Energy Performance Contracts

The idea of performance contracting started in France over 100 years ago with a focus on district heating efficiencies [13], and formed the basis for Energy Service Companies (ESCOs). The performance contract is essentially a contract where payment is based on performance – this could be efficient supply of energy or conditioned space, or the identification and installation of energy efficient retrofits that will reduce energy consumption/cost over the remaining life of the operation at no up front cost to the owner of the facility.

MODALITIES AND APPLICATIONS

The Energy performance contracting market has developed various models for delivering energy services to customers. The three key models include Shared Savings, Guaranteed Savings and Vendor financing.

Shared Savings

Shared savings was the original model developed in France to provide customers with reduced energy costs. The shared savings approach results in the customer and the ESCO sharing an agreed percentage of the energy **costs** savings that result from the performance contract [13]. In this model the ESCO will raise financing for the energy efficiency measures and effectively takes 'ownership' of any equipment for the life of the contract.

Guaranteed Savings

The guaranteed savings model was developed following the reduction of energy prices in the mid 1980's [13]. This model is based on guaranteeing the **amount of energy** saved by the implementation of energy efficiency measures, subject to an agreed floor price for the energy consumed. As such this type of approach is typically less sensitive to variations in the energy price. By allocating the technical risk to the ESCO, the guaranteed savings model provides a vehicle for recourse should the ESCO fail to deliver and thereby enables customers and financiers to enter into agreements that may have been deemed too risky otherwise.

Vendor Financing

This type of contract is used by a manufacturer to demonstrate the energy efficiency of their equipment and is offered on the basis that equipment is paid for by avoided utility costs. The vendor assumes the majority of the risk, however the customer's choice is limited in terms of vendors and equipment and ultimately this may limit the magnitude of energy savings that may be realised.

FINANCING BUILDING RETROFITS

In the majority of urban centres around the world, existing buildings predominate over new buildings and typically exhibit inefficient use of water and energy and poor indoor air quality [14].

In many cases with large commercial properties, the owner and the occupant are most likely to be different entities with different financial drivers. The owner is unlikely to see the benefits of retrofit (unless they pay for common utilities in the building or include utility charges in the rent charged to tenants). This represents a barrier to entering the market for energy efficiency projects, as there is typically limited direct impact on the operations of the building owner (albeit that building retrofits may have the added benefit of extending the service life of the building).

On the other hand, the tenant is unlikely to come forward to finance upgrades for fixed assets they do not own and cannot liquidate when they decide to move on. The tenant's position presents a barrier to the tenant being able to benefit from being involved in the energy efficiency market and realising potential energy and costs savings that would affect day-to-day operations costs of their business.

Performance contracting is likely to be most attractive as a vehicle for building envelope retrofits where it can be demonstrated (in theory and practise) that the proposed envelope retrofit will provide:

- Tangible energy and cost savings (that can be measured and verified in accordance with accepted protocols),
- Non-energy benefits that can at least be qualitatively measured using post-occupancy surveys,
- Economic payback within normal short to medium term timeframes; and
- Internal rates of return not less than industry average.

Case study – Delivering envelope upgrades in cool-temperate climate zones

The case study presented considers a hypothetical two level commercial office building with a thermal envelope that does not confirm to energy efficiency standards introduced in New Zealand in the late 1970s. The energy performance of this base building was assessed for cool-temperate climate zones (Zones 2 & 3 as shown in Figure 1) represented by the cities of Wellington and Christchurch. Heating/cooling degree-day profiles are shown in Figures 1a and 1b. [1]

BASE CASE

The base case scenarios consider a two level office building with a square footprint of 38.7 m × 38.7 m and GFA of 3000 m^2. The construction was assumed to consist of reinforced concrete floors, frame, roof and walls with a suspended ceiling system, carpet (with underlay) on floors and a built-up roof.

Using eQuest (a building simulation software package based on the DOE-2 simulation software [16]), and assuming software-selected HVAC system sizing, the baseline energy consumption was determined for each location. The annual energy consumption and equivalent building energy performance indices were as shown in Table 1.

In all simulation runs the model assumed no variation in the type, numbers and performance of equipment installed in the building. Operating schedules were consistent with NZ standard guidelines and artificial lighting requirements were consistent for each case. The primary variables across the two climate zones are thus:

- Energy consumption for space heating
- Energy consumption for water heating

UPGRADE SCENARIOS

The upgrade scenarios considered were:

- Phase 1 - Reduction of envelope infiltration (from a base case of 21.3 $m^3/h{\bullet}m^2$ to 0.69 $m^3/h{\bullet}m^2$ – approximately 96% reduction)
- Phase 1 + Phase 2 – Increase insulation levels to meet at least the minimum requirements of NZS 4243: Part 1: 2007

OUTCOMES

The outcomes of the performance upgrades are presented in Figure 2.

The reduction of envelope infiltration and improvement of insulation levels of the base building is simulated to determine reduction in energy consumption (primarily for space heating) between 45% and 50%.

Peak energy consumption loads were also reduced by approximately 65% in comparison to the baseline scenario.

IMPACTS

Financial

The actual financial impact of these upgrades is somewhat dependant on the cost of energy to the consumer and the implementation cost. In New Zealand the energy cost consists of a consumption charge and a supply charge.

Typical consumption charges were based on data provide by Contact Energy, Wellington, NZ (see Table 2).

Supply tariffs vary regionally based on consumer demands, infrastructure costs and distances from generation capacity. Tariffs for each region (Wellington, Christchurch) were obtained from disclosure statements available on the websites of the following suppliers:

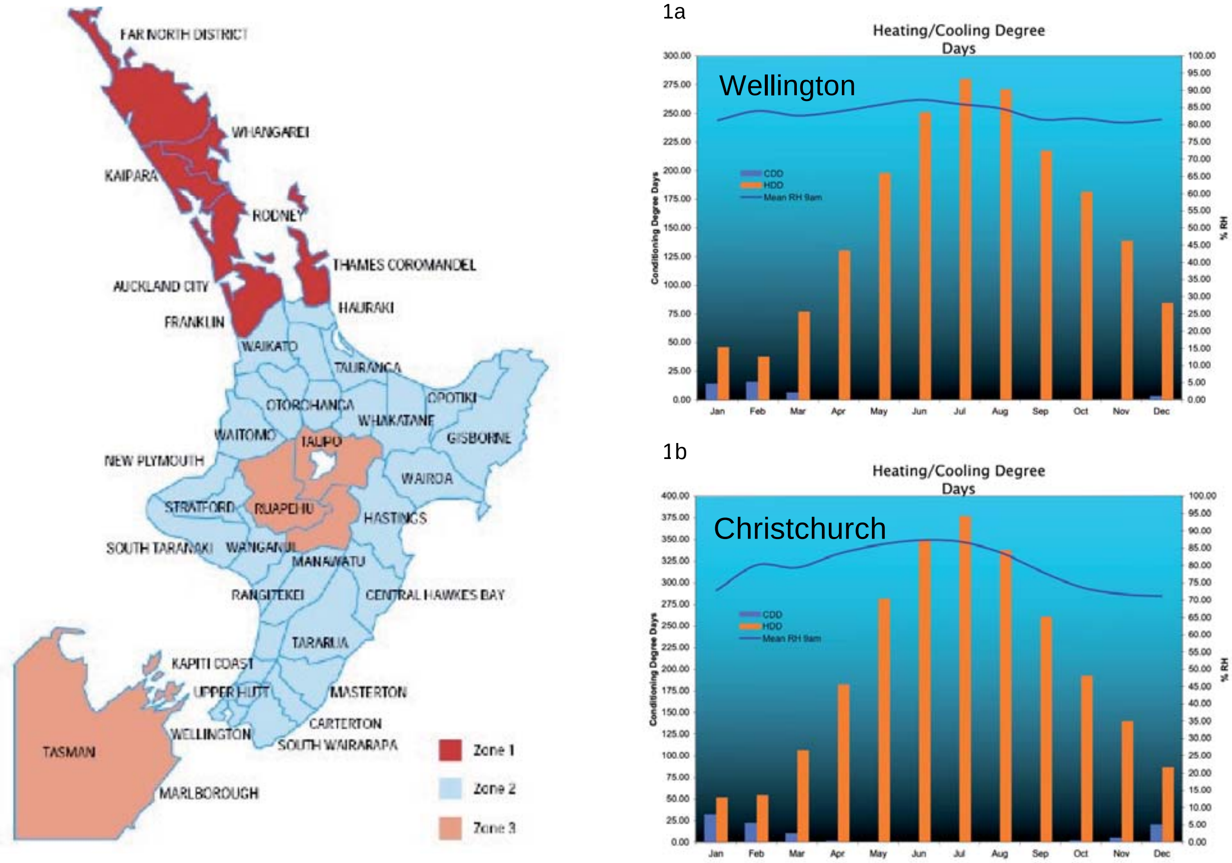

Figure 1 Climate Zones Defined in New Zealand Energy Efficiency Codes. Figure 1a – Heating/Cooling Degree-Day profile – Wellington, NZ. Figure 1b – Heating/Cooling Degree-Day profile – Wellington, NZ

Table 1 Baseline energy consumption and performance index

Location	Baseline energy consumption (kWh x 000)	Building Energy Performance Index (kWh/m^2)
Wellington (Climate Zone 2)	376	125
Christchurch (Climate Zone 3)	457	152

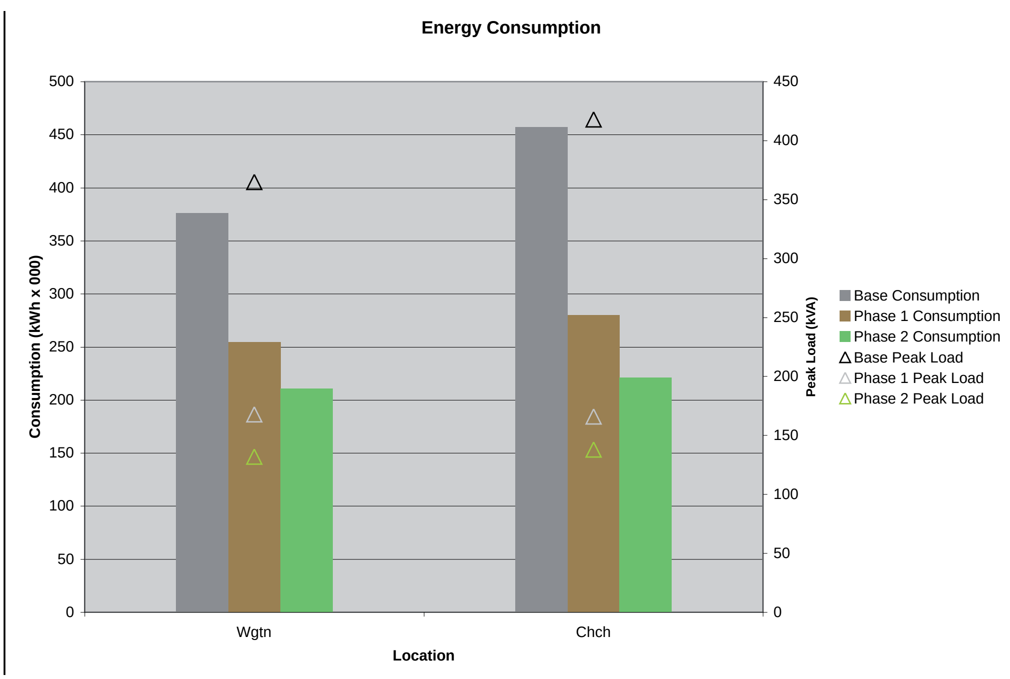

Figure 2 Impact of upgrades on energy consumption and peak load requirements.

Table 2 Summary of Consumption Tariff Structure

Time of Use		Building Energy Performance Index (¢/kWh)
00:00-08:00	Weekdays	14.921
08:00-00:00		16.498
00:00-08:00	Weekends	13.705
08:00-00:00		15.230

Table 3 Benchmark Supply Tariffs

Climate Zone	Total connected load (kVA) *assumes PF = 0.8	Annual supply charge
Wellington	365	$9,271
Christchurch	418	$22,841

Table 4 Benchmark Energy Costs

Climate Zone	Annual consumption (kWh x 000)	Annual consumption charge	Total energy cost
Wellington	376	$61,873	$69,944
Christchurch	457	$73,519	$96,360

- Wellington – United Networks (http://www.unitednetworks.co.nz)
- Christchurch – Orion Group (http://www.oriongroup.co.nz)

The analysis assumed supplies would be low voltage (i.e. 400V) connections.

Table 3 presents the benchmark supply tariffs.

The benchmark energy costs are presented in Table 4.

The financial impacts are summarised in Figure 3.

It is clear that in addition to actual energy consumption figures, the upgrades have also had an impact on the peak energy requirements, which has a financial impact for the consumer. In Wellington, the simulation indicates a saving of 19% in supply charges – in Christchurch, due in part to a different cost structure; the simulation indicated a reduction in supply charges in excess of 50%. This reduction in peak demand also has flow-on effects to utilities supplying the area in which the building is located (i.e. reduced infrastructure requirements and ability to re-distribute load during peak periods).

The financial viability of these projects (when considering delivery via energy performance contracting) is influenced by the Life-cycle cost. As with the energy costs, implementation costs will vary from region to region and are dependant on materials costs and transaction costs. In the scenarios considered, the transaction costs for the phase 2 upgrades (which assumes implementation of phase 1) accounted for between 32% and 35% of the estimated total implementation cost.

A summary of the lifecycle and simple payback analysis is presented in Table 5.

The analysis completed indicated that for Wellington, the simple payback period would be approximately 22 years and the net present value of the projects was negative, indicating that the investment was not viable. For Christchurch the outcome of the life cycle analysis for Phase 2 was positive and simple payback was less than 13 years. The primary reasoning for this outcome: the baseline consumption was much higher – and the energy end-use split was heavily weighted toward space heating in Christchurch. The upgrade scenarios modelled therefore had a much greater impact on reducing total energy consumption (a total reduction of >50% compared to the baseline).

More in depth analysis of a particular building to value the human and environmental benefits such as improved productivity, reduced absenteeism and staff retention is likely to reveal that and the true value of such retrofit projects to the occupier is much greater than the cost savings from energy consumption reductions alone.

Operational

As noted by Qiu and Haghighat [15], infiltration into the building envelope can lead to excessive ingress of moisture, particularly when a mechanical ventilation system is in operation. This can lead to condensation, which can encourage mould growth – a common problem associated with "sick building syndrome". Moisture ingress can also impact the durability of the building envelope.

Reducing infiltration through the building envelope has the potential to provide the following benefits in addition to energy savings:

- Reduction in moisture ingress and therefore risk of mould growth.
- Reduction of draughts that may result in uneven temperatures within the building – improved occupant comfort.
- Improved ability of HVAC system to maintain temperature and humidity levels within acceptable occupant comfort zones.

Upgrading the insulation has the potential to provide the following benefits in addition to energy savings:

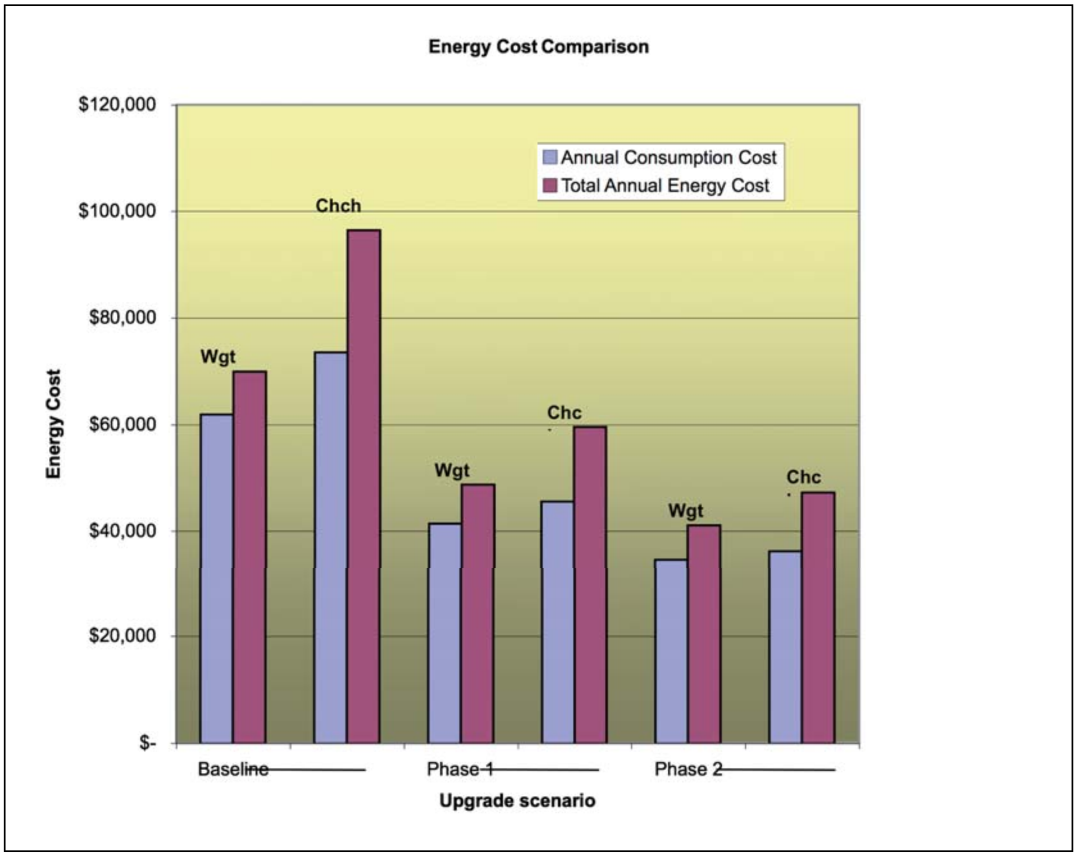

Figure 3 Impact of upgrades on annual energy costs.

Table 5 Life Cycle Cost and Simple Payback Summary

Retrofit phase	Wellington Simple payback	Wellington NPV	Christchurch Simple payback	Christchurch NPV
1	1.2 years	$171,453	0.7 years	$326,668
2	22 years	($237,159)	12.9 years	$15,813

- Reduced heat gain/loss through the envelope resulting in fewer "hot" or "cold" spots.
- Fewer hot and cold "peaks" enabling the HVAC system to provide more stable temperatures within the office based on the internal loads rather than external loads.

Occupational

Other benefits that cannot be directly modelled using an energy simulation include:

- Improved occupant productivity
- Reduced absenteeism

In addition to occupant health benefits, upgrading of the building envelope can provide the opportunity to improve or rejuvenate the aesthetics of the building. While this may have an impact on the property's capital value, it can potentially improve the public amenity of the building.

Framework for delivery

While the energy and financial analysis presented indicates that an envelope retrofit project may be economically viable, without a suitable framework in place to encourage the implementation of such projects, improvement of energy efficiency in tenanted commercial office spaces in NZ (or elsewhere in the world) is unlikely to be realised, in the absence of significant government regulation. An alternative to potentially stifling regulation is the adoption of "Green Leases", which aim to remove the typical barriers to energy efficiency presented by split incentives associated with traditional tenancy agreements (i.e. envelope improvements may benefit the tenant through reduced energy consumption, at the cost of the owner who has no recourse).

CONVENTIONAL COMMERCIAL LEASES

In the conventional commercial lease, the tenant relies on the building owner to provide useable space with sufficient utilities for the tenant to be able to conduct their business. While a commercial office building must comply with building codes applicable at the time of construction, there is often no requirement to upgrade buildings as codes change – unless they are subject to major refurbishment at the owner's expense. Typically tenants are not able to make modifications to the building envelope to improve energy performance, and indeed there is little incentive to do so as the long-term benefits are unlikely to be realised by the tenant. This situation is commonly referred to as a split incentive or *the tenant-owner dilemma*– whereby the costs and benefits of any material changes to a building are apportioned unevenly between the building owner and the tenant. This presents a significant barrier to the implementation of energy efficiency initiatives in leased buildings, and particularly in commercial buildings, where energy efficiency improvement usually requires significant investments due to larger, centralized building end-use energy technologies (e.g. building envelope, HVAC etc.).

GREEN LEASES

Green leases have been developed to encourage energy efficiency in commercial office buildings and to differentiate properties in the market. In Australia, the Commonwealth Government has developed the *Green Lease Schedules* program with the aim of providing a legal framework between building owners and their tenants that encourages energy efficient and cost effective operation of their buildings. The legal framework is in the form of a detailed schedule that is appended to the tenancy agreement. This schedule defines the commitments of the owner and tenant to various performance targets associated with the maintenance and operation of the building including:

- Indoor air quality
- Energy use and emissions
- Metering
- Tenancy operations (energy & resource efficiency)
- Transportation
- Maintenance and cleaning

By providing a legal framework that encourages energy efficient operations, the risks of split incentives that arise from the standard lease agreement are identified and allocated to each party to the green lease.

By effectively agreeing to minimum performance targets, the owner and tenant agree to maintain (or improve) minimum levels of energy efficiency. This commitment to efficient operations provides the basis for the consideration of energy efficiency projects delivered via energy performance contracts.

Green Leases have been deployed for commercial properties in Australia (from 2006 onwards) and Canada (from 2004 onwards) and the concept is gaining traction in the United Kingdom and United States of America [17]. Not all Green Leases use a prescriptive schedule (as implemented in Australia), however the basic premise is that the Green Lease should define minimum performance targets in terms of energy efficiency (and other relevant parameters) and allocate responsibility for delivery on these targets to either the building owner or to the tenant.

UPGRADE PROJECT DELIVERY FRAMEWORK

Conventional lease agreements lead to split incentives where building operation and building ownership may be vested interests of distinct entities. Such agreements present barriers to the implementation of energy efficiency projects. Choosing to deliver energy efficiency projects using energy performance contracts can remove the following barriers to energy efficiency:

- Risk – with energy performance contracts structured using the guaranteed savings model, the risk is transferred to the ESCO, thereby reducing the exposure of the building owner/tenant
- Access to finance – again an energy performance contract structured using the guaranteed savings model where risk allocation and management and project goals are clearly defined presents a more attractive proposition to financiers
- Access to knowledge – ESCOs engaged to implement energy performance contracts can provide the requisite knowledge and skills to identify energy efficiency opportunities and develop energy management plans that can be implemented by building owners/tenants

However, overcoming barriers due to split incentives requires a different approach to the traditional lease agreement.

For existing buildings and tenancies, incorporating a Green Lease Schedule (GLS) (based on the Australian Green Lease Guide) is proposed as a workable solution for enabling landlords and tenants to work towards more energy efficient buildings through upgrades delivered via energy performance contracts. Without the green lease, or green lease schedule appended to a standard lease, the is little incentive for either the building owner or tenant to consider investing in energy efficiency initiatives that may result in long term benefits for the other party.

Figure 4 shows a green leasing and energy performance-contracting framework.

The project lifecycle for an energy performance contract being procured for a building subject to a GLS is likely to include on-going monitoring for an agreed period which would enable the customer to repay financing and the ESCO to fulfil contractual obligations and realise income (see Figure 5).

While monitoring is typically included in energy performance contracts in order to quantify the actual savings achieved, and therefore the split of savings between the client and the ESCO, this on-going monitoring requirement would also fulfil performance monitoring requirements of the Green Lease/ Green Lease Schedule.

It would also provide access to building performance information that the building owner and tenant may not have otherwise had access to – thereby removing the information barrier that can dissuade owners and tenants from considering energy efficiency projects.

Conclusions

Improving the energy efficiency in existing buildings is likely to be a key strategy for achieving reductions of anthropogenic emission of greenhouse gases (GHGs) in the years ahead. In

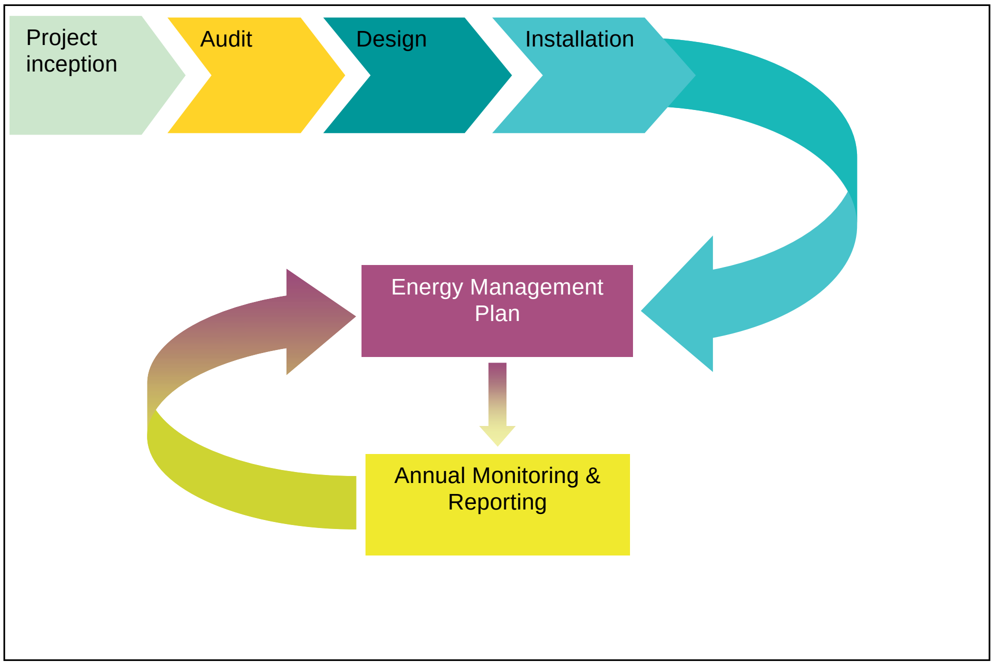

Figure 5 Energy performance contract project lifecycle.

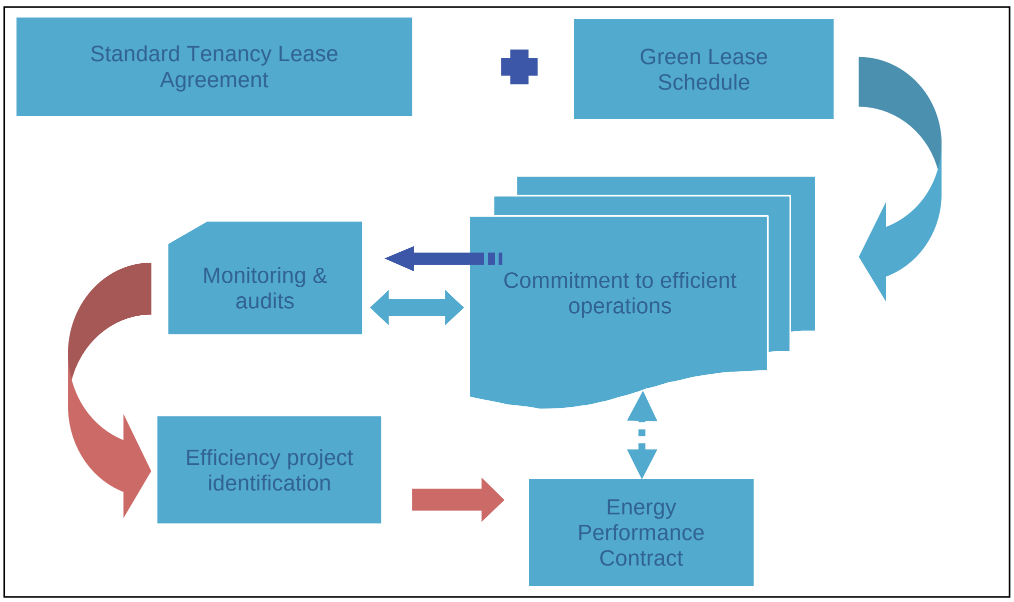

Figure 4 Framework for green lease and energy performance contracts.

order to implement such strategy, various barriers must be overcome and markets developed.

Upgrading the building envelope can be shown to significantly improve building energy performance overall and potentially reduce peak load requirements (which can influence local infrastructure requirements and load distribution). In the larger urban context, implementation of these improvements on a larger scale can lead to significant:

- Energy demand reductions,
- Greenhouse Gas emission reductions,
- Reduction of investment required for new power generation/peak supply infrastructure in urban areas,
- Improvements in productivity.

Delivery of significant improvements in energy efficiency in commercial buildings (and reduction of GHGs in our urban areas) will require building owners (or tenants) to consider building envelope upgrades. This will require a shift away from the traditional commercial lease agreements towards Green Leases. Green leases would provide the basis for the implementation of energy efficiency project delivery frameworks the incorporate energy performance contracts to provide incentives for all parties to consider energy efficiency upgrade projects by removing major barriers including risk (technical and financial), access to finance, access to information and split incentives.

Such frameworks will enable project proponents to consider the delivery of energy efficiency upgrade projects using energy performance contracting, which will help project teams to:

- Raise project finance,
- Manage project risks,
- Formalise project objectives,
- Obtain guarantees for agreed project outcomes.

While energy performance contracting can remove barriers to energy efficiency, the success of this strategy relies on various factors including:

- Energy cost awareness of building owners and occupiers.
- The configuration of the building being assessed.
- A willingness by building owners and operators to consider energy efficiency initiatives.
- Suitable market structures and frameworks that enable the removal or fair apportioning of split incentives between landlords and tenants (Green Leases).
- A competitive market that encourages professional companies to contribute.
- Access to finance by ESCOs at reasonable rates.
- Attractive life cycle costs and payback periods.

Appropriate intervention through public funding to improve access to information and assessment of energy efficiency opportunities may be required for the energy performance contracting / Green Lease model to provide sufficient incentive for building owners and operators to upgrade the building envelope of their existing facilities.

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Endnotes

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